

## COST-BENEFIT ANALYSIS OF THE INTRODUCTION OF MP-MRI GUIDED BIOPSIES IN CROATIA

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**SUMMARY** – Continuous increase of the cost of medical services around the world has become a major topic in the world today. Multiparametric prostate MRI has recently become a new standard in prostate cancer detection, especially in repeated biopsy settings. The method, although superior in cancer detection rates, is costly and requires additional training and equipment. The purpose of our study was to determine the costs and benefits that arise when introducing this method in prostate cancer diagnostics. Repeated prostate biopsy was performed in 101 consecutive patients in the period from 1 October 2016 to 1 July 2017. Patients were divided into two groups based on whether prostate mp-MRI was performed or not. The prices of specific procedures were obtained from the billing service of the Sestre milosrdnice University Hospital Center and patient models were created to determine financial costs and benefits. The cost of the entire diagnostic process per patient in the non-MRI group was HRK 1.931,05 and HRK 1.848,42 in the mpMRI group, or 4.28% less. Prostate mpMRI and subsequent mpMRI guided biopsies can reduce the overall cost in prostate cancer diagnostics despite the procedure itself being an additional cost. This is achieved by omitting prostate biopsies in patients with low malignancy risk.

**Key words:** *Prostate mp-MRI; Prostate cancer, cost benefit*

### Introduction

Over the last couple of decades, health system funding has become a major topic in the world. We are witnessing a constant increase of the cost of medical services around the world, with almost overwhelming figures being used to describe the prices of individual procedures, diagnostic and therapeutic alike<sup>1</sup>. As medicine as a discipline develops, associated technologies, education programs and facilities also become more complex and often more expensive<sup>1,2,3</sup>. It is therefore

natural that cost-benefit analyses are needed to manage the limited funds available or, to put it more bluntly, to determine which procedures can be afforded by certain health systems and which cannot<sup>4</sup>. It is the opinion of the authors of this paper that no national health care system in the western world can afford to spend funds without rational management and remain solvent.

Prostate cancer (PCa) is the most common male malignancy diagnosed today and as such is followed by large funds being spent to diagnose and manage the disease<sup>2,5</sup>. Until the introduction of multiparametric magnetic resonance imaging (mpMRI) of the prostate, the common diagnostic protocol included a rectal exam and serum PSA to determine the risk of the disease. In case of cancer suspicion, prostate biopsy fol-

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lowed to confirm the presence of malignancy. Prostate mpMRI, as a part of the diagnostic algorithm, has the potential to decrease the number of unnecessary biopsies, but represents a significant increase in the overall cost in diagnosis.

## Methods and materials

In the period from 1 October 2016 until 1 July 2017, repeated prostate biopsy was performed in 101 consecutive patients with elevated prostate-specific antigen (PSA) levels and/or positive digital rectal examination (DRE) and at least one negative prior prostate biopsy. In 24 patients, multiparametric magnetic resonance imaging (mpMRI) was performed and was followed by cognitive fusion prostate biopsy with 8-10 systemic and 1-3 targeted cylinders, in line with the European Association of Urology guidelines. In 77 patients, only classic, repeated systematic transrectal ultrasound guided biopsy (TRUS) was performed, without previous imaging. Prostate mpMRI was done at least 6 weeks after the last biopsy and suspected lesions were labeled and graded according to Prostate Imaging Reporting and Data System, version 2 (PI-RADS v-2). Conventional system biopsy was performed in patients without detectable lesions. Patients were classified into the mpMRI and non-mpMRI group according to the preferences of their urologists. For the purposes of the cost-benefit analysis, the mpMRI group was further divided into the omitted biopsy group (OB-mpMRI, patients with PIRADS lesions 1, 2 and 3) and biopsy performed group (B-mpMRI, patients with PIRADS lesions 4 and 5). Our cost-benefit analysis started with an office visit, when a decision was made to perform either a repeated systematic prostate biopsy or prostate mpMRI. It ended with the visit where either the mpMRI results were discussed with the patient, and the conclusion was reached that the biopsy was not required, or with the visit where prostate biopsy findings were discussed if rebiopsy was indicated. The price of each procedure was obtained from the billing service of the Sestre milosrdnice University Hospital Center. A cost analysis was done, which included the number and the cost of visits to the urologist's office, as well as the number and the cost of all diagnostic and therapeutic procedures and other expenses for each group. The course of clinical procedures and decisions was standardized based on the av-

erage for each of the observed groups and was converted to 100 patient models for easier comparison of results. Finally, three groups with concurring models were created. The calculations were based on the obtained models. The study was approved by our institution's Ethics Committee, and each patient signed an informed consent.

## Results

The cost of the entire diagnostic process per patient in the non-MRI group was HRK 1.931,05. In the OB-mpMRI group, the cost was HRK 1.080,2, compared to HRK 2.759,9 in the B-mpMRI group. The PIRADS distribution and the number of positive biopsies per PIRADS score show that prostate biopsy is only necessary in patients with PIRADS 4 and 5 (46%). The average cost of the entire diagnostic process in the mpMRI group (B-mpMRI + OB-mpMRI) was HRK 1.848,42, and HRK 1.931,05 in the non-mpMRI group, or 4.28% less in the group where prostate mpMRI was utilized. In the non-mpMRI group the cost per cancer detected was HRK 12 859,50 and HRK 5204,85 in the mpMRI group.

## Discussion

Initially, introducing prostate mpMRI in the diagnosis of prostate cancer represents a substantial increase in overall cost, which is understandable. Prostate mpMRI is a complex tool which requires expensive equipment and trained radiologists and technicians. However, the extra cost can be annulled with avoided unnecessary biopsies. Studies such as this one enable us to define the PIRADS biopsy threshold. This means that all the patients with the PIRADS score beneath the threshold can avoid prostate biopsy with a reasonably low risk of a false negative MRI result. In our study, we biopsied all the patients, regardless of their PIRADS score and found that cancer incidence in patients with a PIRADS score under 4 was 0%. Therefore, if we had omitted prostate biopsies on patients with PIRADS score 2 and 3 (no PIRADS 1 cases were detected in our cohort), our overall detection rate would have remain the same. But when reviewing literature, a problem arises. Cancer detection rates for specific PIRADS scores vary greatly in differ-

ent studies. If we look at the studies on which the American Urological Association bases its guidelines, we can see that two of those studies set the PIRADS biopsy threshold at 4 and three set it at 3, based on their results<sup>6,7,8</sup>. From a financial point of view, this is a crucial factor when observing financial benefits. If we set the PIRADS biopsy threshold at 3 in our cohort, an additional 29 % of patients would be biopsied, which would raise the overall cost in the mpMRI group, making the mpMRI cognitive guided fusion biopsy a more expensive method than classic repeated systematic biopsies. We can safely say that with larger specificity comes a lower cost of the method. From this we conclude that the current PIRADS system is not ideal and subjective interpretation is the reason for these discrepancies. In order to determine the PIRADS threshold for each diagnostic team (urologists, radiologists, technicians), studies such as these are useful in order to avoid biopsies not being performed in patients who have a high risk of malignancy, that is, to set a PIRADS biopsy threshold that will allow the urologist to avoid unnecessary prostate biopsies without omitting them in patients with a high probability of malignancy.

When discussing mpMRI guided biopsies the term “cost per cancer detected” is particularly useful in describing the superiority of the method to classic systematic prostate biopsies. In the non-mpMRI group we spent HRK 12 859,50 to detect one prostate cancer and only HRK 5204,85 in the mpMRI group. This is easily explained by a higher cancer detection rate of the mpMRI guided biopsy (37% in the mpMRI group vs 16% in the non-mpMRI group) which means that fewer funds will be spent to detect one prostate cancer if mpMRI is used.<sup>9</sup> The only variable in price formation when mpMRI guided prostate biopsy is used is specificity, since all the other prices are fixed. As specificity grows, less patients need to undergo prostate biopsy which means less funds are spent.

It is important to note that financial cost is not the most important parameter when deciding on the introduction of a new procedure. Diagnostic accuracy, survival rates, patient comfort and many other factors must be evaluated before reaching a decision. In our study, the overall PCa detection rate was significantly higher in the mpMRI group compared to the non-mpMRI group, which is a clear benefit, regardless of financial cost.<sup>9</sup>

## Conclusion

Prostate mpMRI and subsequent mpMRI guided biopsies can reduce the overall cost in prostate cancer diagnostics despite the procedure itself being an additional cost. This is achieved by omitting prostate biopsies in patients with low malignancy risk. Unfortunately, the PIRADS biopsy threshold which is the main parameter for determining the safety of omitting prostate biopsy has still to be clearly defined. Discrepancies among published studies force us to evaluate our own team and define our own threshold so we can safely advise our patients whether to have the biopsy or not, and subsequently reduce the overall cost.

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## Sažetak

ANALIZA ISPLATIVOSTI UVOĐENJA BIOPSIJE PROSTATE  
NAVOĐENE MULTIPARAMETRIJSKOM MAGNETSKOM REZONANCOM

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Kontinuirani rast troškova medicinskih postupaka aktualna je tema i razlog zabrinutosti u cijelome svijetu. Ciljana, multiparametrijskim magnetom (mpMRI) navođena biopsija prostate polako postaje standard u dijagnostici karcinoma prostate, pogotovo kod ponovljene biopsije. Iako superiorna klasičnoj, sistemskoj biopsiji prostate, navedena metoda zahtijeva skupu dodatnu opremu i vješte, educirane kliničare. Naš cilj je analizirati ekonomsku isplativost uvođenja multiparametrijske magnetne rezonance prostate i posljedične kognitivno mpMRI-om navođene biopsije prostate u dijagnostički protokol bolesnika sa inicijalno negativnom sistemskom biopsijom prostate, kod kojih postoji daljnja klinička sumnja na karcinom prostate. U periodu od 01.10.2016. do 01.07.2017 kod 101 uzastopnog bolesnika s povišenim PSA i/ili pozitivnim DRP, a nakon negativne prve TRUS biopsije učinjena je druga, ponovljena biopsija prostate. Bolesnici su podijeljeni u dvije skupine ovisno o tome dali je učinjen mpMRI prostate ili ne. Učinjena je analiza broja i troškova posjeta specijalisti urologu kao i broja i troškova ordiniranih pretraga za svaku skupinu. Tijek kliničkih postupaka standardiziran je na temelju prosjeka za pojedine promatrane skupine te preračunat na 100 bolesnika za svaku skupinu radi lakše usporedbe rezultata. Kalkulacije su vršene na temelju dobivenih modela. Prosječna cijena obrade bolesnika u skupini bez mpMRI-a iznosi 1931,05 HRK dok u sa mpMRI-em iznosi 1848,42 HRK tj. 4,28% manje. Iako mpMRI prostate pojedinačno predstavlja značajan dodatan trošak u dijagnostici karcinoma prostate, kod bolesnika sa inicijalno negativnom biopsijom prostate isti omogućava velikom broju bolesnika izbjegavanje biopsije te posljedično smanjenje ukupnog troška.

Ključne riječi: *Karcinom prostate; Navođena biopsija, isplativost; Multiparametrijska magnetska rezonanca*